WESTON®

MODEL 1220

DIGITAL PANEL METER

INSTRUCTION \ PARTS LIST

70 432-0434-001

INSTRUCTIONS/PARTS LIST

FOR MODEL 1220

DIGITAL PANEL METER

U.S. Patent 3,051,939
and Patents Pending

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WESTON INSTRUMENTS, INC.
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INTRODUCTION

The Weston Model 1220 is a miniature bipolar, high input impedance Digital Panel Meter employing LSI/MOS technology. The units are provided as a single range instrument which can be chosen from one of ten (10) voltage or current ranges. Full scale is 1000 digits with overrange capability to 1999 on all ranges except the 1000 volt DC full scale range. When an input of 1999 is exceeded the leading digit (one) will blink to indicate this condition. The instrument is provided with a "-" indicator to display the polarity of the signal being measured. Accuracy is ±0.1% of reading ±1 digit. The basic range is 100 millivolts at 100 megohm input impedance. The power supply is 5.5 volts DC ±10% at typically 140mA.

The case front has an aperature which "frames" the LED display. The adjustments are made accessible by removing the front. Zero adjustment may be made over a range of greater than ±10 counts.

For a pictorial view of the meter and overall dimensions, refer to Figure 1, Outline Dimensional Drawing.

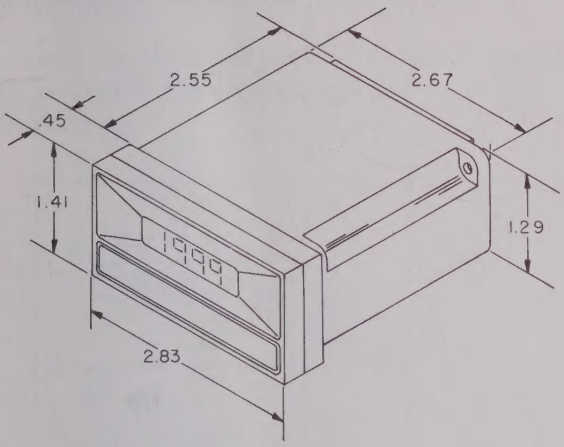


Figure 1. Outline Dimensional Drawing

SPECIFICATIONS

Minimum Range	00.0 to 100.0 mVDC
Overrange	100% (except for 1000V range)
Rated Accuracy	±0.1% of reading ±1 digit
Input Resistance	100M Ω (see Table 1)
Bias Current	75nA max. 30nA typical
Normal Mode Rejection Ratio	30 dB at 60Hz (20 dB for 1 volt unit)
Speed	0.25 seconds per reading
Response Time	1.5 seconds
Maximum Voltage Overload	60VDC (100mV range) see Table 1.
Stability	±0.1% full scale
Voltage Range	5.5VDC ±10% 5VDC at typically 650mV 5.5VDC at typically 750mV 6.0VDC at typically 1000mV
Power	5.5VDC 0.75 watt typical
Weight	Approx. 4 ounces (124 grams)
Operating Temperature	0^{o}C to 60^{o}C
Storage Temperature	-40^{o}C to 70^{o}C

TABLE 1.
TABLE OF SPECIFICATIONS

PART NUMBER	RANGE (DC)	SENSITIVITY	INPUT IMPEDANCE	#FULL SCALE PRESENTATION	MAXIMUM VOLTAGE OVERLOAD
273855	1000V	1.0V	5M Ω	1000	1100V
273854	100V	0.1V	5M Ω	100.0	500V
273853	10V	0.01V	5M Ω	10.00	500V
273852	1V	0.001V	100M Ω	1.000	60V
273851	100mV	0.1mV	100M Ω	100.0	60V
273860	100mA	0.1mA	1 Ω	100.0	—
273859	10mA	0.01mA	10 Ω	10.00	—
273858	1mA	0.001mA	100 Ω	1.000	—
273857	100uA	0.1uA	1KΩ	100.0	—
273856	10uA	0.01uA	10KΩ	10.00	

#With 100% overrange on all ranges except 1000V range.
Max. overrange presentation 1999 on all ranges except 1000V range.

INSTALLATION

Panel Mounting

1. Unpack the meter and perform a visual inspection to assure that no damage has occurred during shipment or handling.

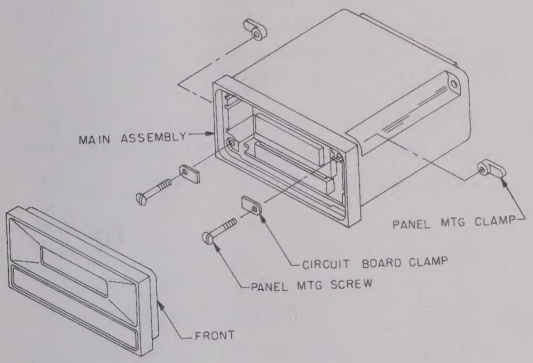


Figure 2. Meter Mounting Drawing

2. Remove front by pulling on any one of its corners.
3. Front Panel Mounting. Rotate two mounting screws (located in diagonal corners) 3 or 4 times counter-clockwise to position mounting cams correctly. Mount main assembly (see Figure 2) on a panel 1/16 to 1/8 inch thick. The panel shall be prepared in accordance with panel cut-out dimensions shown in Figure 3. Rotate two mounting screws clockwise to position mounting cams in lock position and secure meter to panel. Snap front to meter.
4. Rear Panel Mounting. Prepare panel as shown in figure 4. Remove two each panel mounting screws, circuit board clamps and panel mounting clamps. Position meter on panel and secure with two round head screws no. 4-40 x 1/4 inch long and two PEM fastener standoffs for 1/16 inch panel no. 4-40 thd, part no. BSOS-440-10.

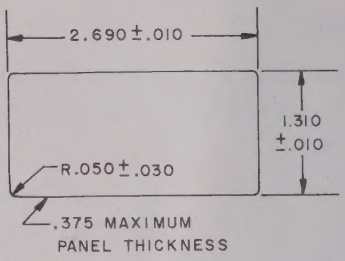


Figure 3. Cut-Out Dimensions for Front Panel Mounting

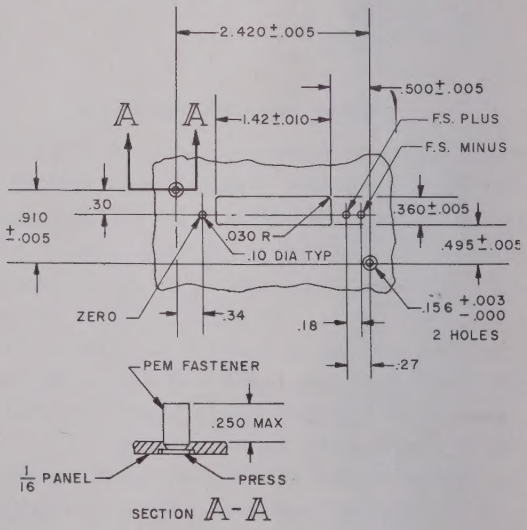


Figure 4. Cut-Out Dimensions for Rear Panel Mounting

ADJUSTMENT AND OPERATION

Operation

The Digital Panel Meter has provisions to accept a connector at the rear of the case. A connector package is supplied as an accessory under Part Number 273883-901. It consists of connector, CONTINENTAL NO. 600-4PC-GE-10 and two screws no. 4-40 thd x 5/8 inch long TAP-TITE screws.

1. Connect a 5.5 volt DC power source as follows:
   a. Plus side of DC source to Pin B
   b. Minus side of DC source to Pin 4 (Power Supply Ground)
   c. Pins L and 8, or 9 and 8 are used for signal inputs dependent upon range.
   d. Pin 8 (Signal Ground) and pin 4 (Power Supply Ground) must be connected together. For optimum results these pins should be connected together at the signal source.

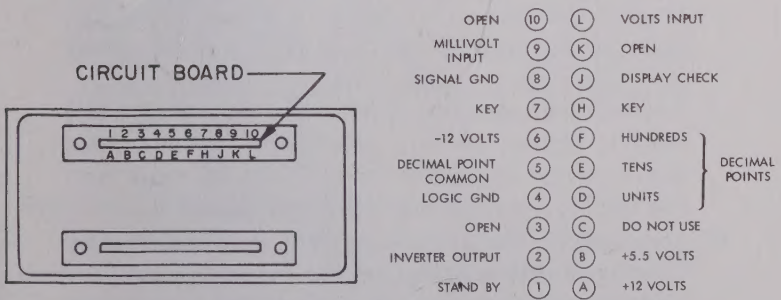

CIRCUIT BOARD
1 2 3 4 5 6 7 8 9 10
A B C D E F H J K L
OPEN (10) (L) VOLTS INPUT
MILLIVOLT INPUT (9) (K) OPEN
SIGNAL GND (8) (J) DISPLAY CHECK
KEY (7) (H) KEY
-12 VOLTS (6) (F) HUNDREDS
DECIMAL POINT COMMON (5) (E) TENS
LOGIC GND (4) (D) UNITS
DECIMAL POINTS
OPEN (3) (C) DO NOT USE
INVERTER OUTPUT (2) (B) +5.5 VOLTS
STAND BY (1) (A) +12 VOLTS

Figure 5. Rear View of Pin Designations

2. Allow meter to warm up for 15 minutes.
3. Remove front if front panel mounted. Remove meter if rear panel mounted.
4. Short signal input pins; Pin 9 (+) and Pin 8 (-). Rotate left zero adjust potentiometer with a screw driver until meter indciates 00.0 and minus (-) polarity lamp blinks. For 10V through 1000V ranges substitute Pin L for Pin 9.
5. Connect a standard source to the signal input pins. Apply full scale voltage and rotate positive full scale adjust potentiometer with a screw driver until meter indicates 1000 ±1 digit.
6. Reverse input signal. Connect a standard source to the signal input pins. With full scale voltage applied rotate negative full scale adjust potentiometer with a screw driver until meter indicates -1000 ±1 digit.
7. Repeat steps 4, 5 and 6 as necessary until proper adjustment is achieved. The meter is now ready for operation.
8. Full scale digital presentation is tabulated in Table 1. However, the meter is capable of being operated beyond this range plus 100% or minus 100%. For example, the operational range of 1 Volt DC meter is +1.999 volts to -1.999 volts.
9. An overrange situation exists when more than 1.999 volts is applied on a 1 volt range. If the applied input voltage is greater than ±200% of range only the leading one digit will illuminate and blink.
10. Selection of the decimal point is accomplished by shorting a solder bridge on the display board. The bridges are numbered D1 through D3 referring to the most significant digit which the decimal point follows.

11. The following table depicts basic conditions which may exist during the course of normal meter operation. The example given is for a one volt range meter.

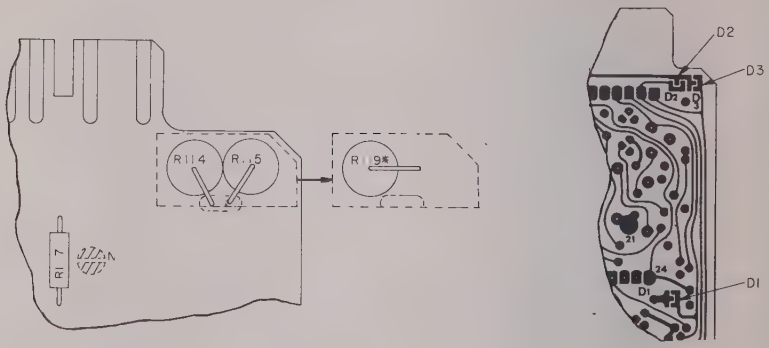
APPLIED SIGNAL VOLTAGE	INDICATION ON DISPLAY
+2.000 & higher	1.XXX (Blinking)
+ .000 to 1.999	.000 to 1.999
- .000 to 1.999	- .000 to 1.999
- 2.000 & higher	-1.XXX (Blinking)

12. To verify that all display segments are indicating, ground the edge connector terminal J. All segments will blink, then remain illuminated.
13. In order to conserve battery power, connect a push-to-read switch (N.C.) across edge connector terminals 1 and B. The "-" and leading one digit will illuminate and blink.
14. If it is desired to remotely select the decimal point, connect wire leads to edge connector terminal D (units), E (tens), F (hundreds), and 5 (decimal point common). Any decimal internally bridged must be removed.

Range and Readout Slope Changes

Range changing is easily accomplished in the instrument. Table 2 shows the component values for any of 10 ranges and figure 6 shows the location of components and solder bridges on the upper and lower circuit boards.

Slope (input vs readout) adjustments are made in a similar manner. If a readout is desired in engineering units, i.e., feet, pounds, RPM, etc., which do not directly relate to the input, data can be provided instructing how to determine values of range resistors for particular applications.



Upper Circuit Board

Lower Circuit Board

*NOTE: For 10V & 100V ranges, top lead wire from R119 connected to same solder pad as R115 bottom lead.

Figure 6. Location of Range Changing Components and Solder Bridge

TABLE 2
RANGE CHANGING

RANGE	UPPER BOARD					LOWER BOARD
	SOLDER BRIDGE N	R117	R114	R115	R119	DECIMAL POINT SOLDER BRIDGE
10uA	Bridge	10K Ω	—	—	—	Bridge D2
100uA	Bridge	1K Ω	—	—	—	Bridge D3
1mA	Bridge	100 Ω	—	—	—	Bridge D1
10mA	Bridge	10 Ω	—	—	—	Bridge D2
100mA	Bridge	1 Ω	—	—	—	Bridge D3
100mV	Bridge	—	—	—	—	Bridge D3
1V	Open	—	—	—	—	Bridge D1
10V	Bridge	49.9K Ω	—	—	4.95M Ω	Bridge D2
100V	Bridge	4.9K Ω	—	—	4.95M Ω	Bridge D3
1000V	Bridge	499 Ω	2.49M Ω	2.49M Ω	—	All Open

THEORY OF OPERATION

GENERAL

This section in conjunction with the block diagram Figure 7 and waveforms Figure 8 contains a discussion of the theory of operation of the Digital Panel Meter.

Basically, the instrument is a single range, high input impedance, bi-polar digital panel meter that is capable of being constructed as a voltmeter or current meter with the addition of an appropriate attenuator or shunt. Standard self-contained current or voltage ranges are available from Weston as shown in Table 1.

The instrument utilizes a dual slope integrating technique designed with sampling intervals related to the power line frequency. Dual slope is a method of A/D conversion which grants immunity to random and power frequency noise accompanying the input signal and to power supply ripple. Integrating time is typically 250 milliseconds, providing rejection of 60Hz and 400Hz whose periods are sub-multiples of 250 milliseconds.

Dual slope converts the input signal into a ratio of two time intervals, both proportional to clock period making the accuracy of conversion independent of clock accuracy. The accuracy of conversion is dependent upon the stability of the internal reference circuits.

Waveforms are shown in Figure 8. The integrating time T is constant at 250 milliseconds, corresponding to 10,000 pulses from the 40KHz clock oscillator.

The cycle is divided into two intervals; ramp up t_1 and ramp down t_2. During t_1, the integrator charges to a voltage $\frac{e_{in}\, t_1}{RC}$

During t_2, the capacitor discharges an equal amount under the influence of e_{in} and I_{Ref} such that:

$$\frac{e_{in}\, t_1}{RC} = \frac{(I_{Ref} - e_{in})\, t_2}{R\ C}$$

and since $t_1 + t_2 = T$ $t_2 = \dfrac{e_{in}\, T}{I_{Ref} R}$

Now the interval T is determined by 10,000 clock pulses and thus lasts $10{,}000/f_{clock}$ seconds. The number of clock pulses N in t_2 is $t_2 \times f_{clock}$ Thus $N = \dfrac{e_{in}\ 10{,}000}{I_{Ref}\ R}$ a quantity independent of f_{clock}. Since the interval t_2 starts at a count of 10,000 (or zero) the count at the end of t_2 is equal to N. A storage command at that time transfers the count into display storage.

The conversion process is cyclic with a conversion every 250 milliseconds. If the new count is the same as the previous one, the number in storage will not change, and no display change results. The key events in each cylce are the count 10,000 which initiates t_2 by introducing a reference current and the crossing of zero by the integrator which terminates t_2 and commands a readout into storage. The polarity of the reference current can be negative or positive depending on the polarity of e_{in}.

MOS OPERATION (See Figure 7.)

The MOS package controls the injection of current references into the integrator-amplifier and has as its only input a zero crossing detector. The output from the MOS package is used to drive a seven segment numeric display.

The overall operation is controlled by two internal flip-flops: one whose states correspond to either interval t_1 or t_2, and a second whose states correspond to either a positive or negative input. The current sources are turned off when the MOS chip detects a zero crossing from the detector. This also initiates a new measurement cycle where the level of the detector during this period alerts the MOS control logic to the polarity of

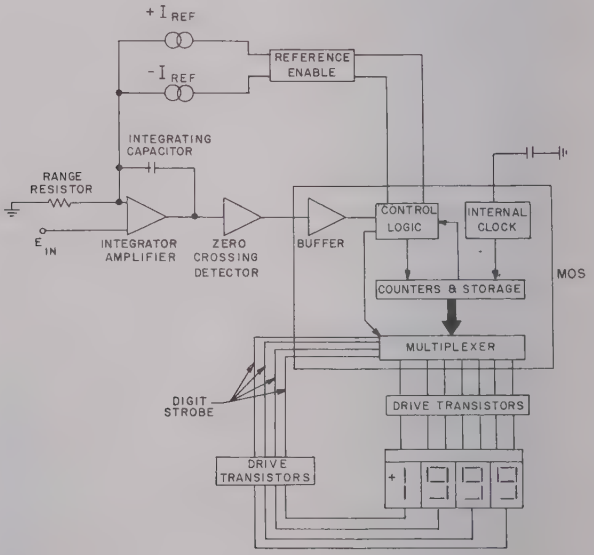


Figure 7. Block Diagram

the signal being measured. Period t_1 continues until the MOS counter reaches the 10,000th count at which time the proper current source is turned on to initiate interval t_2. Integration continues until the zero state is detected through the zero crossing detector. At this point the information on the counters is transferred to latches.

The display is effected by providing a time-multiplexed seven segment code on the same seven lines for all four digits. The individual digits are separated by enabling one display digit at a time as commended by the MOS package. The internal multiplexing is accomplished by driving a four state ring counter by a divided-down clock signal. This counter information is made available externally and is used internally to sequentially gate the individual digits, which are in storage. The complete scan is performed at a 100Hz rate so that no flicker is observable.

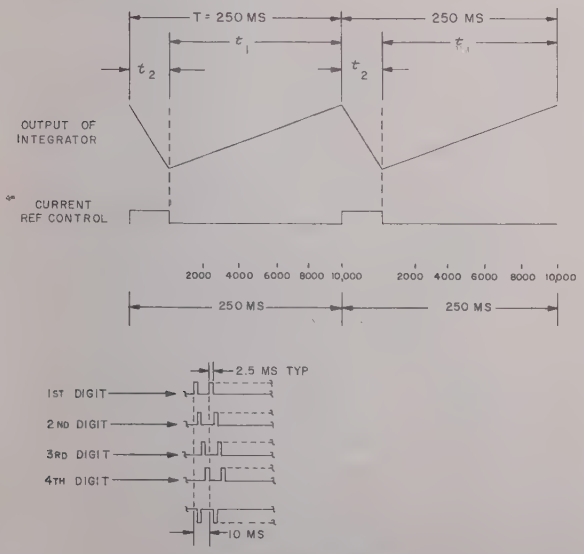


Figure 8. Waveforms

TABLE 3
RANGING COMPONENTS

UPPER BOARD PART NO.	RANGE	R114	R115	R117	R119
273867-901	100mV	–	–	–	–
273867-902	1V	–	–	–	–
273867-903	10V	–	–	269884-001	275625-001
273867-904	100V	–	–	269911-001	275625-001
273867-905	1000V	270197-001	270197-001	270194-001	–
273867-906	10uA	–	–	266627-001	–
273867-907	100uA	–	–	266628-001	–
273867-908	1mA	–	–	269925-001	–
273867-909	10mA	–	–	275594-001	–
273867-910	100mA	–	–	275593-001	–

TABLE 4
COMPONENT DESCRIPTION

PART NO.	DESCRIPTION
266627-001	RESISTOR, 10K ohms ±1%, 1/10 watt
266628-001	RESISTOR, 1K ohms, ±1%, 1/10 watt
269884-001	RESISTOR, 49.9K ohms ±1%, 1/10 watt
269911-001	RESISTOR, 4.99K ohms ±1%, 1/8 watt
269925-001	RESISTOR, 100 ohms ±1%, 1/10 watt
270194-001	RESISTOR, 499 ohms ±1%, 1/10 watt
270197-001	RESISTOR, 2.49M ohms ±1%, 3/4 watt
275593-001	RESISTOR, 1 ohm ±1%, 1/10 watt
275594-001	RESISTOR, 10 ohms ±1%, 1/10 watt
275625-001	RESISTOR, 4.95 ohms ±1%, 1/2 watt

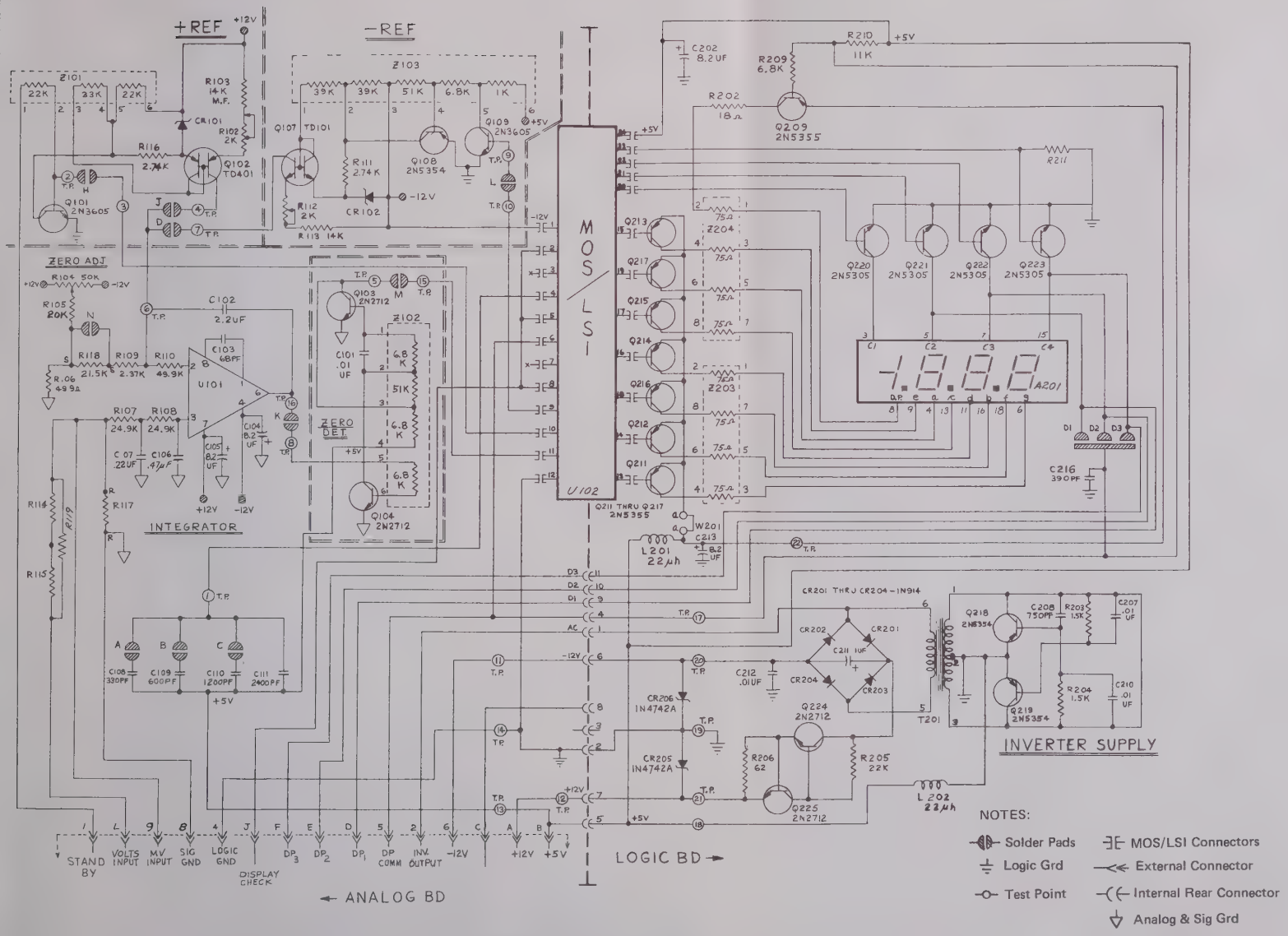


Figure 9. Schematic Diagram,

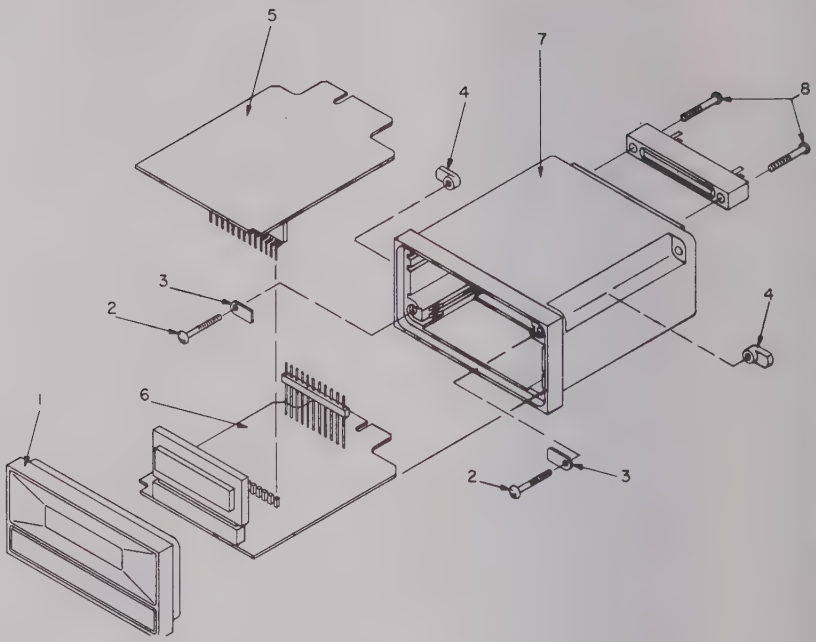


Figure 10. Assembly

ITEM NUMBER	DESCRIPTION	PART NUMBER
	ASSEMBLY (Ref. Figure 10)	
1	FRONT, PRINTED, MILLIVOLT	273876-901
1	FRONT, PRINTED, VOLT	273876-902
1	FRONT, PRINTED, MICROAMPERE	273876-903
1	FRONT, PRINTED, MILLIAMPERE	273876-904
2	SCREW	266623-045
3	CLAMP, CIRCUIT BOARD	265663-001
4	CLAMP, PANEL MTG.	265661-024
5	BOARD ASSY, UPPER (Ref Table 3)	–
6	BOARD ASSY, LOWER	273871-902
7	CASE	273879-901
8	CONNECTOR PACKAGE (Per order)	273883-901

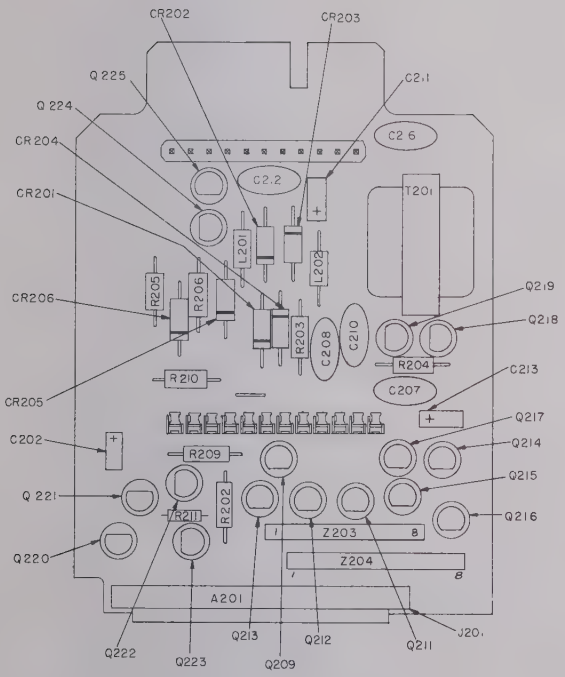


Figure 11. Lower Board Assembly

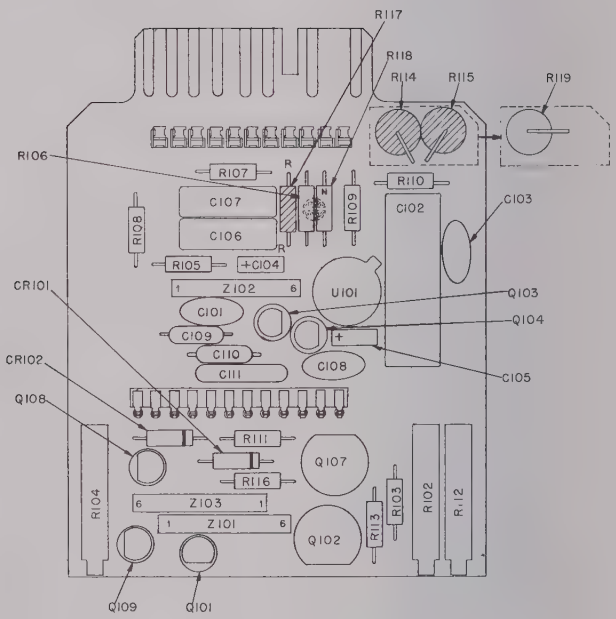


Figure 12. Upper Board Assembly

REFERENCE SYMBOL	DESCRIPTION	PART NUMBER
	LOWER BOARD ASSY (Ref Figure 11)	
A201	DISPLAY ASSY, LED	273863-902
C202	CAPACITOR, 8.2uF ±20%, 15 WVDC	269952-001
C207	CAPACITOR, 0.01uF ±20%, 100 WVDC	ND37639-001
C208	CAPACITOR, 750pF ±10%, 1000 WVDC	274154-001
C210	CAPACITOR, 0.01uF ±20%, 100 WVDC	ND37639-001
C211	CAPACITOR, 1uF ±20%, 35 WVDC	269954-001
C212	CAPACITOR, 0.01uF ±20%, 100 WVDC	ND37639-001
C213	CAPACITOR, 8.2uF ±20%, 15 WVDC	269952-001
C216	CAPACITOR, 750pF ±10%, 1000 WVDC	274154-001
CR201	DIODE, 1N914	ND61025-001
CR202	DIODE, 1N914	ND61025-001
CR203	DIODE, 1N914	ND61025-001
CR204	DIODE, 1N914	ND61025-001
CR205	DIODE, 1N4742A	264601-001
CR206	DIODE, 1N4742A	264601-001
J 201	CONNECTOR, DIGITAL (LED)	272847-001
L201	CHOKE, 22uH ±10%	274145-001
L202	CHOKE, 22uH ±10%	274145-001
Q209	TRANSISTOR, 2N5355	272893-001
Q211	TRANSISTOR, 2N5355	272893-001
Q212	TRANSISTOR, 2N5355	272893-001
Q213	TRANSISTOR, 2N5355	272893-001
Q214	TRANSISTOR, 2N5355	272893-001
Q215	TRANSISTOR, 2N5355	272893-001
Q216	TRANSISTOR, 2N5355	272893-001
Q217	TRANSISTOR, 2N5355	272893-001
Q218	TRANSISTOR, 2N5354	268795-001
Q219	TRANSISTOR, 2N5354	268795-001
Q220	TRANSISTOR, 2N5305	275559-001
Q221	TRANSISTOR, 2N5305	275559-001
Q222	TRANSISTOR, 2N5305	275559-001
Q223	TRANSISTOR, 2N5305	275559-001
Q224	TRANSISTOR, 2N2712	ND39917-001
Q225	TRANSISTOR, 2N2717	ND39917-001

REFERENCE SYMBOL	DESCRIPTION	PART NUMBER
	LOWER BOARD ASSY (Ref Figure 11) Cont.	
R202	RESISTOR, 18 ohms ±5%, 1/4 watt	275565-001
R203	RESISTOR, 1.5K ohms ±5%, 1/4 watt	275561-001
R204	RESISTOR, 1.5K ohms ±5%, 1/4 watt	275561-001
R205	RESISTOR, 22K ohms ±5%, 1/4 watt	275563-001
R206	RESISTOR, 62 ohms ±5%, 1/4 watt	275560-001
R209	RESISTOR, 6.8K ohms ±5%, 1/4 watt	275566-001
R210	RESISTOR, 11K ohms ±5%, 1/4 watt	275564-001
R211	RESISTOR, 3K ohms ±5%, 1/4 watt	269857-001
T201	TRANSFORMER	272155-901
W201	WIRE, JUMPER	265551-912
Z203	RESISTOR, MODULE	274364-001
Z204	RESISTOR, MODULE	274364-001
—	SOCKET, LSI CONNECTOR (12 regd)	272738-077
—	BOARD ASSY, HARDWARE	273871-901
	UPPER BOARD ASSY (Ref Figure 12)	
C101	CAPACITOR, 0.01uF ±20%, 100 WVDC	ND37639-001
C102	CAPACITOR, 2.2uF ±10%, 50 WVDC	275522-001
C103	CAPACITOR, 68 pF ±10%, 1000 WVDC	272422-001
C104	CAPACITOR, 8.2uF ±20%, 15 WVDC	269952-001
C105	CAPACITOR, 8.2uF ±20%, 15 WVDC	269952-001
C106	CAPACITOR, 0.47uF ±20%, 50 WVDC	275647-001
C107	CAPACITOR, 0.22uF ±20%, 50 WVDC	275523-001
C108	CAPACITOR, 330pF ±10%, 1000 WVDC	270044-001
C109	CAPACITOR, 600pF ±10%, 200 WVDC	275591-001
C110	CAPACITOR, 1200pF ±10%, 200 WVDC	275592-001
C111	CAPACITOR, 2400pF ±10%, 200 WVDC	275595-001
CR101	DIODE, ZENER, TEMP COMPENSATED	274203-001
CR102	DIODE, ZENER, TEMP COMPENSATED	274203-001

REFERENCE SYMBOL	DESCRIPTION	PART NUMBER
	UPPER BOARD ASSY (Ref Figure 12) Cont.	
Q101	TRANSISTOR, 2N3605	268796-001
Q102	TRANSISTOR, TD401	269904-001
Q103	TRANSISTOR, 2N2712	ND39917-001
Q104	TRANSISTOR, 2N2712	ND39917-001
Q107	TRANSISTOR, TD101	266399-001
Q108	TRANSISTOR, 2N5354	268795-001
Q109	TRANSISTOR, 2N3605	268796-001
R102	RESISTOR, VARIABLE, 2K ohms ±10%	272869-001
R103	RESISTOR, 14K ohms ±1%, 1/8 watt	274139-001
R104	RESISTOR, VARIABLE, 50K ohms ±10%	272858-001
R105	RESISTOR, 20K ohms ±1%, 1/10 watt	269881-001
R106	RESISTOR, 49.9 ohms ±1%, 1/10 watt	269886-001
R107	RESISTOR, 24.9K ohms ±1%, 1/10 watt	272251-001
R108	RESISTOR, 24.9K ohms ±1%, 1/10 watt	272251-001
R109	RESISTOR, 2.37K ohms ±1%, 1/8 watt	274140-001
R110	RESISTOR, 49.9K ohms ±1%, 1/8 watt	269884-001
R111	RESISTOR, 2.74K ohms ±1%, 1/8 watt	272863-001
R112	RESISTOR, VARIABLE, 2K ohms ±10%	272869-001
R113	RESISTOR, 14K ohms ±1%, 1/8 watt	274139-001
R114	RESISTOR, Selected — Ref Table 3	—
R115	RESISTOR, Selected — Ref Table 3	—
R116	RESISTOR, 2.74K ohms ±1%, 1/8 watt	272863-001
R117	RESISTOR, Selected — Ref Table 3	—
R118	RESISTOR, 21.5K ohms ±1%, 1/10 watt	264691-001
R119	RESISTOR, Selected — Ref Table 3	—
U101	OPERATIONAL AMPLIFIER, LM101A	271852-001
U102	INTEGRATED CIRCUIT, MOS/LSI	272612-901
Z101	RESISTOR, MODULE	273882-001
Z102	RESISTOR, MODULE	273881-001
Z103	RESISTOR, MODULE	272159-001
—	SOCKET, REAR CONNECTOR (11 reqd)	272738-077
—	SOCKET, LSI CONNECTOR (12 reqd)	275570-001
—	BOARD, DRILLED	273865-001

WESTON EQUIPMENT WARRANTY

Weston warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of Seller under this warranty is limited, at Seller's option, solely to repair, replacement with equivalent Weston equipment, at an appropriate credit adjustment not to exceed the original equipment sales price, of equipment returned to the Seller provided that (a) Seller is promptly notified in writing by Buyer upon discovery of defects, (b) Upon receipt of written authorization from Seller the defective equipment is returned as directed, transportation charges prepaid by Buyer, and, (c) Seller's examination of such equipment discloses to his satisfaction that defects were not caused by negligence, misuse, improper installation, accident, or unaurhorized repair or alteration by the Buyer. Any modification such as changing range resistors may void this warranty.

This warranty does not include mechanical parts failing from normal usage nor does it cover limited life electrical components which deteriorate with age such as tubes, lamps, etc.

This warranty is in lieu of all other warranties, expressed or implied, including the implied warranty of fitness for a particular purpose to the original purchaser or to any other person. Seller shall not be liable for consequential damages of any kind.

The aforementioned provisions do not extend the original warranty period of any article which has been either repaired or replaced by Seller.

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